Lehrstuhl für Flugantriebe
Technische Universität München

Project Outline

Project KonRAT: Application of rocket engines components for aerospace transport systems

Key objectives:
- Design procedures within turbopumps for cryogenic oxygen
- Investigation of selected problems in turbopumps
- Development and manufacturing of stage- and engine valves
- Additive layer manufacturing for aerospace applications

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.

Motivation

Launch vehicle

Mission requirements:
- Upper stage
- LDH/LOX
- Expander cycle
- Thrust F = 110 ... 150 kN
- Specific impulse $I_{sp} > 450$ s

Suborbital flight

Mission requirements:
- Gas Generator cycle
- Methan/LOX
- Thrust F = 400 ... 600 kN
- Specific impulse $I_{sp} > 340$ s

Turbopump activities for:

Some facts:
- Start of the project: 01.2015
- Project duration: 3 years

Cooperation with 3 industrial partners and DLR
- 4 PhD students at TUM for turbopump topics

Project Overview

Institute for Flight Propulsion
Project coordination within TUM

Operating life cycle & loads:
- System analysis at component level in order to:
  - verify determining design parameters
  - determine stationary as well transient loads

CFD-Simulations of flow phenomena:
- Determination of stationary as well transient flow, pressure and load distributions within turbopumps

Institutes involved at TUM:

DLR Institute of Space Propulsion within LFA
Secondary systems:
- Gap flow
- Bearing lubrication and cooling
- Sealing gas
- Axial balancing

Institute of Applied Mechanics

Dynamic behaviour & bearing:
- Rotordynamics
- Bearing effects
- Seal phenomena
- Transient loads
- Blade forces
- Modelling and simulation
- Validation on various experimental setups

Institute for Computational Mechanics

Fluid-structure interaction:
- Development of combined finite element simulation tools for multiphysical contact applications
- Linking a fluid-structure interaction framework with contact interaction and heat transfer phenomena
- Detailed analysis of surface contact and friction in bearings and seals of the turbopumps

Contact

Prof. Dr.-Ing. Oskar Haidn
haidn@ifa.mw.tum.de
+49 89 289 16084

M.Sc. Lucrezia Veggi
veggi@ifa.mw.tum.de
+49 89 289 16194

Dipl.-Ing. Bernd Wagner
diplbm013@dlr.de

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.

© Ansys
© Airbus DS
© FTT,Inc.
© ESA
© DLR Institute of Space Propulsion within LFA

Institute of Applied Mechanics

Dynamic behaviour & bearing:
- Rotordynamics
- Bearing effects
- Seal phenomena
- Transient loads
- Blade forces
- Modelling and simulation
- Validation on various experimental setups

Institute for Computational Mechanics

Fluid-structure interaction:
- Development of combined finite element simulation tools for multiphysical contact applications
- Linking a fluid-structure interaction framework with contact interaction and heat transfer phenomena
- Detailed analysis of surface contact and friction in bearings and seals of the turbopumps

Contact

Prof. Dr.-Ing. Oskar Haidn
haidn@ifa.mw.tum.de
+49 89 289 16084

M.Sc. Lucrezia Veggi
veggi@ifa.mw.tum.de
+49 89 289 16194

Dipl.-Ing. Bernd Wagner
diplbm013@dlr.de

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.

© Ansys
© Airbus DS
© ESA

Institute of Applied Mechanics

Dynamic behaviour & bearing:
- Rotordynamics
- Bearing effects
- Seal phenomena
- Transient loads
- Blade forces
- Modelling and simulation
- Validation on various experimental setups

Institute for Computational Mechanics

Fluid-structure interaction:
- Development of combined finite element simulation tools for multiphysical contact applications
- Linking a fluid-structure interaction framework with contact interaction and heat transfer phenomena
- Detailed analysis of surface contact and friction in bearings and seals of the turbopumps

Contact

Prof. Dr.-Ing. Oskar Haidn
haidn@ifa.mw.tum.de
+49 89 289 16084

M.Sc. Lucrezia Veggi
veggi@ifa.mw.tum.de
+49 89 289 16194

Dipl.-Ing. Bernd Wagner
diplbm013@dlr.de

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.

© Ansys
© Airbus DS
© ESA

Institute of Applied Mechanics

Dynamic behaviour & bearing:
- Rotordynamics
- Bearing effects
- Seal phenomena
- Transient loads
- Blade forces
- Modelling and simulation
- Validation on various experimental setups

Institute for Computational Mechanics

Fluid-structure interaction:
- Development of combined finite element simulation tools for multiphysical contact applications
- Linking a fluid-structure interaction framework with contact interaction and heat transfer phenomena
- Detailed analysis of surface contact and friction in bearings and seals of the turbopumps

Contact

Prof. Dr.-Ing. Oskar Haidn
haidn@ifa.mw.tum.de
+49 89 289 16084

M.Sc. Lucrezia Veggi
veggi@ifa.mw.tum.de
+49 89 289 16194

Dipl.-Ing. Bernd Wagner
diplbm013@dlr.de

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.

© Ansys
© Airbus DS
© ESA

Institute of Applied Mechanics

Dynamic behaviour & bearing:
- Rotordynamics
- Bearing effects
- Seal phenomena
- Transient loads
- Blade forces
- Modelling and simulation
- Validation on various experimental setups

Institute for Computational Mechanics

Fluid-structure interaction:
- Development of combined finite element simulation tools for multiphysical contact applications
- Linking a fluid-structure interaction framework with contact interaction and heat transfer phenomena
- Detailed analysis of surface contact and friction in bearings and seals of the turbopumps

Contact

Prof. Dr.-Ing. Oskar Haidn
haidn@ifa.mw.tum.de
+49 89 289 16084

M.Sc. Lucrezia Veggi
veggi@ifa.mw.tum.de
+49 89 289 16194

Dipl.-Ing. Bernd Wagner
diplbm013@dlr.de

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.

© Ansys
© Airbus DS
© ESA

Institute of Applied Mechanics

Dynamic behaviour & bearing:
- Rotordynamics
- Bearing effects
- Seal phenomena
- Transient loads
- Blade forces
- Modelling and simulation
- Validation on various experimental setups

Institute for Computational Mechanics

Fluid-structure interaction:
- Development of combined finite element simulation tools for multiphysical contact applications
- Linking a fluid-structure interaction framework with contact interaction and heat transfer phenomena
- Detailed analysis of surface contact and friction in bearings and seals of the turbopumps

Contact

Prof. Dr.-Ing. Oskar Haidn
haidn@ifa.mw.tum.de
+49 89 289 16084

M.Sc. Lucrezia Veggi
veggi@ifa.mw.tum.de
+49 89 289 16194

Dipl.-Ing. Bernd Wagner
diplbm013@dlr.de

Incorporation with the ‘integrated system’ research group at the Ludwig Bölkow Campus

- Concentration and further development of core competencies for rocket propulsion systems in Bavaria.